

1                                   **HIGH SPEED TURNOVER APPARATUS AND METHOD**  
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4       **Cross Reference to Related Applications**

5                                   This application claims the benefit of U.S. provisional Serial No. 60/430,767,  
6       filed December 3, 2002.

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8       **Background of the Invention**

9                                   This invention concerns apparatus for turning over articles as they are being  
10       conveyed past a station. This may be done in order that an inspector is able to observe a reverse  
11       side of the article, as for example, board and lumber pieces conveyed sideways past a grader.  
12       Other conveyed articles such as doors, panels, etc., may need to be inverted for assembly or  
13       processing steps.

14                                  For many years, human lumber grade sorters stood at inspection stations next to a  
15       board conveyor and manually turned over the pieces passing by the station.

16                                  This manual operation was practical at the low speeds at which earlier conveyors  
17       operated, i.e., 40-50 pieces per minute.

18                                  Subsequently, conveyors have been speeded up to 100 or more pieces per minute.  
19       At these rates, a turnover apparatus is necessitated in order that human inspectors can carry out  
20       the grading tasks without undue physical stress.

21                                  Such apparatus has heretofore been developed which have been able to operate  
22       successfully with up to 100 pieces per minute.

23                                  See U.S. Patent 6,446,785 B1 for an example of a currently available board  
24       turnover apparatus.

1 Even higher conveyor rates have now been achieved, i.e., 200 boards per minute  
2 or more, and a turnover apparatus and method capable of reliably achieving such rates has not  
3 heretofore been developed. This is believed to be because of the difficulties encountered in  
4 reliably synchronizing the turnover action of separately driven flipping mechanisms with the  
5 conveyor movement at these higher rates.

6 It is the object of the present invention to provide a turnover apparatus and  
7 method of the type described which is capable of reliably turning over conveyed articles such as  
8 boards at a rate substantially in excess of 100 articles per minute.

#### 9 10 Summary of the Invention

11 The above object as well as other objects which will be understood upon a reading  
12 of the following specification and claims are achieved by conveyor carried components which act  
13 on the articles to achieve turnover as the article is being conveyed. Speed up belts engage the  
14 underside of the conveyed articles such as boards or lumber pieces to be pushed ahead on the  
15 conveyor to be abutted against an upwardly projecting pair of lugs, each lug affixed to a  
16 respective one of two (or more) conveyor chain loops at spaced locations there along. Articles  
17 are initially loaded onto the conveyor chain loops into the space behind each lug set. The lugs  
18 each have a rear facing undercut surface creating a rearward facing overhung edge spaced above  
19 the conveyor chain loops.

20 The conveyor chain loops also each have a series of angled flipper arms, each  
21 pivotally mounted thereto at one end to the conveyor chain at a location behind a respective lug  
22 set. A downwardly protruding cam surface on each flipper arm is aligned with a respective

1 adjustable angle cam ramp located at a turnover station, so as to be engaged as each flipper arm  
2 is carried into the station by the conveyor chain loop movement. Each flipper arm has an  
3 upwardly angled segment which is driven up to engage the leading side of a conveyed article  
4 located behind a respective lug set by a camming action created by engagement with the  
5 adjustable angle cam ramp.

6 This causes the conveyed article to be elevated to an on edge condition behind the  
7 lugs. The speed up belts continues to drive the bottom of the article towards the lugs so that  
8 engagement with the overhung edge tips the top of the conveyed article to the rear, which then  
9 falls over, completing the turnover of the conveyed article. Since the flipper arms and lugs are  
10 carried on the conveyor chain loops, this eliminates any problems associated with improper  
11 synchronization of the engagement therewith at high conveyor speeds.

12 Optional let down elements may also be pivotally mounted to each conveyor chain  
13 loop at the location on the conveyor chain loop out on the opposite side thereof, which are  
14 cammed up by engagement with an entrance segment of a second cam ramp to engage the upper  
15 side of the on edge article and are controllably lowered by motion allowed by a downwardly  
16 sloped exit segment of the second cam ramp, to control the downward dropping movement of the  
17 article over being tipped over.

### 18 19 Description of the Drawings

20 Figure 1 is a plan view of a conveyor incorporating the turnover apparatus  
21 according to the present invention, depicting conveyed board pieces and a human grader in  
22 phantom lines.

1               Figure 2 is an enlarged fragmentary view in elevation of a portion of one side of  
2 the conveyor showing the components of the turnover apparatus according to the present  
3 invention.

4               Figure 3 is a partially sectional end view of the conveyor of Figure 1 incorporating  
5 the turnover apparatus according to the invention.

6               Figure 4 is a pictorial view of some of the components and conveyor portions  
7 shown in Figure 2, with a conveyed board piece shown in phantom lines.

8               Figure 5 is a diagram of the speed up belt drive incorporated in the apparatus of  
9 Figure 1 showing the drive and recirculation thereof.

10              Figure 6A-6F are views of turnover apparatus components in successive positions  
11 as a board piece turnover is executed by the apparatus.

12              Figure 7 is a side elevational view of a conveyor chain loop having an optional let  
13 down element mounted thereon, and a second cam ramp positioned to be engaged by a portion of  
14 the let down element when advanced past the same by circulation of the conveyor loops.

15              Figure 8 is a side elevational view of the optional components shown in Figure 7,  
16 with the let down element depicted therein shown in two different positions.

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18              Detailed Description

19              In the following detailed description, certain specific terminology will be  
20 employed for the sake of clarity and a particular embodiment described in accordance with the  
21 requirements of 35 USC 112, but it is to be understood that the same is not intended to be  
22 limiting and should not be so construed inasmuch as the invention is capable of taking many

1 forms and variations within the scope of the appended claims.

2 Referring to the drawings, Figure 1 is an overhead view of a conveyor 10  
3 including two recirculating conveyor chain loops 12, 14 advancing articles shown as pieces 16 of  
4 lumber or boards extending across the upper surface of the chain loops 12, 14 loaded into spaces  
5 20 between a series of lugs 22 connected to the conveyor loops 12, 14. The pieces 16 are  
6 frictionally engaged by the conveyor chain loops 12, 14 and thereby advanced sideways to a  
7 turnover station 18 where a human grader may be in a position as indicated. The apparatus is  
8 usable in various other applications such as assembly operations and with other conveyed  
9 articles, such as doors, windows, fish crates, etc.

10 Each piece 16 is initially loaded onto the conveyor chain loops 12, 14 disposed  
11 within the aligned spaces 20 defined between a series of spaced apart lugs 22 affixed to each  
12 conveyor chain loop 12, 14.

13 Each lug 22 is constructed with a pair of metal plates 24 attached to a chain link  
14 with a guide piece 26 (made of UHMW plastic, for example) sandwiched between the plates 24  
15 extending well above the top of the associated chain conveyor loop 12, 14 and having a curved  
16 engagement surface 28 facing rearwardly towards the direction from which each chain conveyor  
17 loop 12, 14 is advancing. This creates an overhung trailing edge beneath which the piece 16 can  
18 normally fit in abutting the lugs 22 when lying flat on the conveyor.

19 Also mounted to conveyor chain loop 12, 14 is a series of spaced apart flipper  
20 elements, here comprised of flipper arms 36, each aligned with a respective flipper arm 36 on the  
21 opposite chain loop 12, 14 and each located just to the rear of an associated lug 22. Each flipper  
22 arm 36 (constructed of UHMW plastic, for example) has a first segment 38 which normally is

1 inclined downwardly (Figure 2) connected to a second segment 40 extending upwardly at an  
2 angle therefrom. This forms a knee 39 at a lowermost point of each flipper arm 36 which  
3 functions as a cam engaging surface used for a purpose as will be described below.

4 The first segment 38 is pivotally mounted by a link pin 42 that is fastened to a  
5 conveyor chain loop 12, 14, having a projecting end received in a pivot hole in the upper end of  
6 the first segment 36.

7 A guide slot 44 in the second segment 40 is engaged by a guide pin extension 46  
8 of a second chain link pin (Figure 4).

9 An angled cam ramp 48 is adjustably mounted to each frame side member 32 at  
10 the turnover station 18 aligned with the flipper arms 36 so as to engage the same, causing each  
11 set of flipper arms 36 to simultaneously pivot the same about a respective pin 42 causing the tip  
12 of the second segment 40 to swing up and engage the leading side of a board or lumber piece 16  
13 to raise the same. The cam ramp 48 is preferably pivoted at one end to allow adjustable  
14 positioning of its slope by manipulation of a threaded rod 49 to achieve a proper camming action  
15 for a particular article and conveyor speed.

16 A pair of speed up belt assemblies 50 are located within the chain conveyor loops  
17 12, 14 at the turnover station 18, each of which having an endless drive belt 51 which has a  
18 straight segment 51A parallel to the conveyor chain loops 12, 14 but which are slightly elevated  
19 (approximately one half inch) so as to engage the underside of the boards or lumber pieces 16  
20 disposed on the chain conveyors. The speed up drive belts 51 are driven by a motor 52 or other  
21 means so as to be recirculated around idlers 54 and along a straight path parallel to the chain  
22 conveyors 12, 14. Idler 54A is mounted to a tension adjuster mechanism 56 (Figure 5).

1           The belts 51 are driven at a slightly faster speed than the conveyor chain loops 12,  
2 14 to slide the pieces 16 forward on the conveyors chain loops 12, 14, the use of two drive belts  
3 51 insuring that the pieces 16 are moved evenly. Operation of the speed up belts 51 causes the  
4 pieces 16 to be advanced on the conveyor chain loops 12, 14 until the leading edge thereof abuts  
5 a lower rear surface of a set of lugs 22, as shown in Figure 6A prior to activation of the flipper  
6 arms 36.

7           Figures 6B and 6C show the flipper arms 36 raising the leading edge of the piece  
8 16. The curved lug surface 28 guides the leading edge of the piece 16 up and rearwardly.

9           This motion presents the trailing edge of the piece 16 to the speed up belts 51  
10 which drive the piece 16 up quickly to an on edge position seen in Figure 6D and thereafter drive  
11 the lower edge forward so that the upper side of the piece 16 contacts the overhung trailing rear  
12 edge of the lug part 24, seen in Figure 6E. Further advance causes the piece 16 to be tipped over  
13 as seen in Figure 6F to the inverted or turnover position seen in Figure 6F.

14           This method and apparatus has reliably achieved rates of 200 boards per minute  
15 due to the perfect synchronism provided by the conveyor loops carried lugs and flipper arms.

16           Various numbers of conveyor chain loops and grading stations for example can be  
17 provided in a given installation as is well known to those skilled in the art.

18           The various components can be of various sizes to be matched to the size of the  
19 articles conveyed, with an adjustment of the cam ramp also enabling accommodation of the  
20 apparatus to different size articles.

21           Another option particularly useful for larger sized articles such as doors, windows,  
22 etc., to prevent damage when the article is flipped over, is the addition of sets of curved let down

1 elements 56, each pivoted to one of the conveyor chain loops 12, 14 on the opposite side from  
2 the swing up flipper arms 36 (not shown in Figures 7 and 8). A representative let down element  
3 56 is shown in Figures 7 and 8.

4 A second double sloped cam ramp 58 is mounted to the conveyor frame  
5 positioned to engage the lower surface 60 of the let down element 56 as the conveyor chain loops  
6 12, 14 advance the elements 56 past the secondary cam ramps 58.

7 The secondary cam ramps 58 includes an upwardly inclined entry surface segment  
8 62A and a downwardly inclined trailing surface segment 62B. The let down element 56 has a  
9 curved “reverse comma” shape which is thicker at the top to engage larger sized articles. The let  
10 down element 56 are gravity biased, tending to swing counterclockwise about a chain pivot 64 as  
11 viewed in Figures 7 and 8.

12 Contact with the entry segment cam surface 62A causes the let down elements 56  
13 to swing up so that the upper end 66 engages the side of a piece 16 which has been driven up to  
14 an on edge position as described above.

15 As the lower side of piece 16 is advanced by the speed up belts 51 to be tipped  
16 over, the surface 60 reaches the exit segment of surface 62B and the let down element begins to  
17 be allowed to pivot down under the weight of the tipped piece 16 but at a rate constrained by the  
18 slope of the exit ramp 62B. This prevents too rapid dropping of the piece 16, avoiding any  
19 resultant damage to the piece 16 or conveyor parts which could otherwise occur.